Electronic Version
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Claims

[c1] 1. A fabrication method for a shallow trench isolation region, the method comprising:
forming a mask layer over a substrate;
patterning the substrate to form a trench using the mask layer as an etching mask;
filling partially the trench with a first insulation layer;
performing a surface treatment process to form a treated layer on a surface of a part of the first insulation layer;
removing the surface treated layer;
forming a second insulation layer on the first insulation layer and filling the trench; and
removing the mask layer to form a shallow trench isolation region.

[c2] 2. The method of claim 1, wherein the trench comprises a first aspect ratio, and the trench that is partially filled with the first insulation layer comprises a second aspect ratio, and the second aspect ratio is equal or smaller than the first aspect ratio.

[c3] 3. The method of claim 1, wherein a width of the trench after the removing of the treated layer is greater than the width of the trench before the removing of the treated

layer.

[c4] 4. The method of claim 1, wherein a depth of the trench is substantially the same before and after the removing of the treated layer.

[c5] 5. The method of claim 1, wherein the surface treatment process includes a tilted ion implantation process.

[c6] 6. The method of claim 5, wherein the tilted ion implantation process is conducted at an angle of about 30 degrees to about 60 degrees.

[c7] 7. The method of claim 5, wherein a dopant used in the tilted ion implantation process includes a nitrogen gas, an argon gas or other inert gases.

[c8] 8. The method of claim 5, wherein an energy level for the tilted ion implantation process is between 20KeV to 100KeV.

[c9] 9. The method of claim 5, wherein a dopant concentration for the tilted ion implantation process is about 1E15/cm2 to about 1E16/cm2.

[c10] 10. The method of claim 1, wherein the removing of the surface treated layer includes performing a wet etching process.

[c11] 11. The method of claim 1, wherein forming the first insulation layer and the second insulation layer includes performing a high density plasma chemical vapor deposition method.

[c12] 12. A trench filling method, comprising:
providing a substrate, wherein an opening is formed in the substrate;
filling a portion of the opening with a first material layer;
performing a surface treatment step to form a treated layer on a sidewall surface of the first material layer;
removing the treated layer; and
forming a second material layer on the first material layer and filling the opening.

[c13] 13. The method of claim 12, wherein the opening comprises a first aspect ratio before filling the opening with the first material layer, and the opening comprises a second aspect ratio after filling the opening with the second material layer.

[c14] 14. The method of claim 12, wherein a width of the opening after the removing of the treated layer is greater than the width of the opening before the removing of the treated layer.

[c15] 15. The method of claim 12, wherein a depth of the

opening after the removal of the treated layer is substantially the same as the depth of the opening before the removing of the treated layer.

[c16] 16. The method of claim 12, wherein the surface treated step includes a tilted ion implantation step.

[c17] 17. The method of claim 16, wherein the tilted ion implantation is conducted at angle of about 30 degrees to about 60 degrees.

[c18] 18. The method of claim 16, wherein a dopant used in the tilted ion implantation process includes an nitrogen gas, an argon gas or other inert gas.

[c19] 19. The method of claim 16, wherein an energy level in the tilted ion implantation process is about 20KeV to about 100KeV.

[c20] 20. The method of claim 16, wherein a dopant concentration for the tilted ion implantation process is about $1E15/cm^2$ to about $1E16/cm^2$.